Plant names encode Tašlḥit knowledge of Morocco's High Atlas landscapes

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Hanna Soldal[1], Carles Múrcia[2], Ahmed Ouhammou[3], Julie A. Hawkins[4], Gary J. Martin[5,1], Rajindra K. Puri[1], Irene Teixidor-Toneu[6]*

1 Centre for Biocultural Diversity, School of Anthropology and Conservation, University of Kent, Canterbury (UK)

2 Facultat de Filologia i Communicació, Universitat de Barcelona, Barcelona (Spain)

3 Herbier Régional MARK, Faculté des Sciences Semlalia de Marrakech, Cadi Ayyad Université, Marrakech (Morocco) - ORCID 0000-0001-9206-1617

4 School of Biological Sciences, University of Reading, Reading (UK) - ORCID 0000-0002-9048-8016

5 Global Diversity Foundation, Marrakech (UK/Morocco)

6 IMBE, Aix Marseille Univ, Avignon Univ, CNRS, IRD, Marseille (France) - ORCID 0000-0002-7122-2044

*corresponding author, irene.teixidortoneu@imbe.fr

ABSTRACT

In the High Atlas mountains in southern Morocco the relationship between people and landscape is profound, producing rich and dynamic biocultural diversity. In this paper we investigate the ways in which language, in particular plant names, expresses the intrinsic link between Tašlḥit speakers and their environment. We document plant names and explore how these encode local knowledge of landscape and biodiversity as well as social histories. Two complementary field studies were carried out in the High Atlas communes Imgdal and Ukaymdn. In both sites we documented plant names along with local definitions and perceptions of place, vegetation and habitat through structured and semi-structured interviews. We also documented perceived trends of change in the local botanical environment. In Imgdal the diversity of plant names was also explored using herbarium prompts, whilst in Ukaymdn local definitions of ethnoecological categories were studied in more depth. We analyse the diversity and multiplicity of Tašlḥit life form terms, descriptive terms as well as plant names and compare these to scientific taxonomy. We conclude that current social and environmental change, especially climate change, could present a threat to the High Atlas biocultural diversity.

KEYWORDS

Language diversity; Indigenous vocabulary; vernacular names; biodiversity; conservation; global change

INTRODUCTION

Biocultural diversity "comprises the diversity of life in all its manifestations: biological, cultural, and linguistic, which are interrelated (and possibly coevolved) within complex social-ecological systems," (Maffi, 2007: 269). Language encodes cultural values, knowledge and practices and mediates interactions and mutual adaptations between humans and the environment (Maffi, 2007). In particular, the culture-specific ways in which biological diversity is named vocalise local perceptions of the environment (Björa et al., 2015; Hunn, 2006). Local natural histories are distilled in the lexicon used to describe the natural world (Lévi-Strauss, 1962), as animal and plant names express "what is seen most clearly by Native eyes" (Hunn, 2006: 181; Soyolt et al., 2013). Plant names can be a single word (single-lexeme names), but many names are complex and made of two lexemes by the construction "generic name + modifier" (Berlin, 1973). Binomial terms do not necessarily refer to plants conceptually subordinate to their monomial counterparts (Berlin, 1973). Much information is encoded in modifiers in complex names, but identifying sets of words that share a lexical root as well as loan words from other languages can also be revealing. Animal and plant names can refer to relevant ecological characteristics of the named taxa or of the environment in which they live (Alcántara-Salinas et al., 2016). Through linguistic borrowing, they can also evidence historical events and social realities such as migration histories (Van Andel et al., 2014) or contact and exchange between neighbouring linguistic communities (Chirkova et al., 2016).

In the Mediterranean basin, a centre of plant diversity hosting over 20,000 plant species (Heywood, 1995; Medail & Quezel, 1997; Myers et al., 2000), the relationship between people and landscapes is profound. Mediterranean landscapes have co-evolved with people and require human management to sustain plant and animal biodiversity richness (Blondel, 2006; Bugalho et al., 2011; Gauquelin et al., 2018). Considered one of the world's biodiversity hot-spots due to exceptional concentration of endemic species, its biodiversity often results from ecological heterogeneity, shaped by diverse climatic and geographical conditions as well as traditional agricultural practices and livelihoods (Atauri & de Lucio, 2001). All these aspects of Mediterranean biocultural diversity are apparent in the High Atlas Mountains in south-western Morocco.

The High Atlas Mountains are mostly inhabited by Išlḥiyn (Ishelhin) people. They are the Amazigh or Berber ethnic group of central west Morocco who speak Tašlḥit (Tashelhit), an Amazigh language from the Afroasiatic phylum. They are sedentary agro-pastoralists that still rely on their cultural landscapes for subsistence needs. In the High Atlas Mountains, most households rear livestock, mainly cows, sheep, and goats. Local inhabitants hold a large body of environmental knowledge including of food, medicinal, fodder and veterinary uses of plants and of the ecology of these plants, which guides decisions on resource use (Teixidor-Toneu et al., 2016, 2022; Davis, 1996). Ecological knowledge, widely shared through exchange networks, enhances the population's resilience and adaptation to local environments as it facilitates predictions of and responses to environmental fluctuations (e.g., drought and floods) and so ensures continued access to diverse resources (Blanco & Carrière, 2016).

In this paper, we investigate the ways in which language, in particular plant names, express the intrinsic link between Tašlḥit speakers and their environment. We document the plant names and evaluate how nomenclature encodes information about (1) the different kinds of plants identified by Tašlḥit speakers, (2) the habitats in which these plants grow, (3) ecological interactions and evolutionary relationships between species, (4) implicit or explicit evidence of historical contact with other societies, or (5) information about the species' use. We explore

how the use of this vocabulary, and the perception of the environment might be changing. Documentation of folk names contributes to the conservation of biocultural diversity, endangered by social change and economic development. Our study contributes to fulfilling the four priority actions proposed by Wilder et al. (2016) to confront the biocultural diversity crisis: (1) it documents local names of many wild and cultivated plant species and places in Tašlḥit; (2) it identifies convergence as well as incongruences between Tašlḥit taxonomies and Western scientific ones; (3) it is based on a documentation project and stewardship by local researchers; and (4) through this documentation work, culturally significant species were identified and made the focus of *in-situ* management and recovery programs in order to sustain local livelihoods.

METHODS

This article combines two complementary field studies, both carried out in the context of the Global Diversity Foundation's High Atlas Cultural Landscapes Programme (Figure 1). The first study was conducted in several villages of the rural commune of Imgdal between May and June 2015. Situated about 75 km south of Marrakech amidst the High Atlas mountains and neighbouring national park of Toubkal, the rural commune of Imgdal has an area of approximately 274 km^2 and a population of 5467 people living in 1156 households dispersed in 28 small villages (HCPS, 2014). The second study was conducted between April and May 2017 in another rural High Atlas commune, Ukaymdn (Oukaïmeden), situated 80 km south of Marrakech in a valley parallel and contiguous to Imgdal's. In 2004, Ukaymdn had a total population of 4376 inhabitants, living in 655 households (HCPS, 2004). Tašlḥit is the main language spoken in both field sites, but most men also have basic communication skills in Moroccan Arabic and 10% are fluent in this language (HCPS, 2014). In both sites we documented plant names and local definitions and perceptions of place, vegetation and habitat and perceptions of change through structured and semi-structured interviews (Martin, 1995). While in Imgdal we emphasised documenting the breadth of plant names used, in Ukaymdn we focused on detailing the locally defined landscape ethnoecology. Given the geographical and cultural proximity of the two sites and their inhabitants, results from the two field visits are complimentary. Non-structured, informal interviews and participant observation allowed further collection of contextual insights and complementary information.

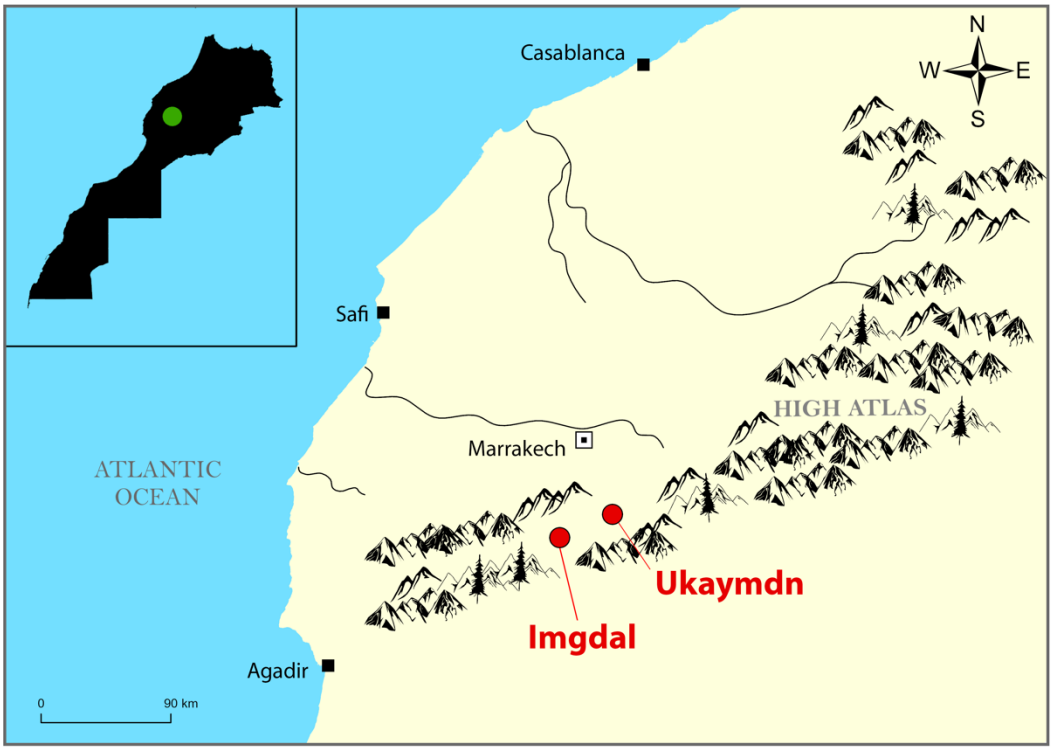

Figure 1. Study sites in the Moroccan High Atlas: Imgdal and Ukaymdn.

In Imgdal, we conducted structured interviews using herbarium specimens as visual cues to identify and name local plants. One hundred and nineteen herbarium voucher specimens (116 vascular plants and three ferns) were selected from a set of 480 to represent medicinal plants (reported in a previous study; Teixidor-Toneu et al., 2016), common plant species in the area including crops, diverse botanical life forms and plants growing in different habitats. The voucher specimens used were part of the local herbarium of Imgdal, which in the spring of 2015 included 480 specimens and for which duplicates are also deposited in the MARK regional herbarium at Cadi Ayyad University, Marrakech. For each plant specimen, residents were asked for its local name, type of plant (stem-habit or folk life form (*sensu* Berlin, 1992)) and where it grows (both locations and habitat types). The 19 participants interviewed were randomly selected across eight hamlets in Imgdal based on people's availability. A total of 119 plants were identified with local names by participants.

In Ukaymdn, a focus was on detailed documentation of the Tašlḥit ethnoecological landscape classification, which includes different patches of land cover and land use, which we refer to as ethnoecological categories (equivalent to *ecotopes* by Hunn and Meilleur, 2010). In total, 74 informants participated. They were asked to freelist all the valley's ethnoecological categories. Semi-structured interviews in combination with participatory mapping exercises (Puri, 2010a) were used to discuss the local landscape ethnoecological classification system and the medicinal plants that were obtained from the different areas. To be able to distinguish apparently similar or identical ethnoecological categories from each other, pile sorts (Martin, 1995) were carried out. Weighted ranking exercises (Puri, 2010b), comparing different habitats' perceived importance as collection sites for medicinal plants, were performed. With

the guidance of key informants, the ethnoecological categories mentioned during interviews and found in close proximity were visited. Medicinal plants were photographed *in situ*, collected and prepared as herbarium voucher specimens (n=86), before they were deposited in the MARK regional herbarium at Cadi Ayyad University, Marrakech. A total of 57 local medicinal plant names were mentioned by the participants.

Botanical identification was achieved through the study of herbarium specimens that were deposited at the Regional Herbarium MARK, University Cadi Ayyad, Marrakech. The *Flore Pratique du Maroc* (Fennane et al., 1999, 2007, 2014) was used and nomenclature and family assignments follow World Flora Online (WFO, 2023). Amazigh and Moroccan Arabic phytonyms are transcribed according to a standard phonological transcription: a /ɐ/, b /b/, g /g/, g^w /g^w/, d /d/, ḍ /$d^ʕ$/, ə [ə], f /f/, k /k/, k^w /k^w/, h /h/, ḥ /ħ/, ɛ (Amazigh) and ʕ (Moroccan Arabic) /ʕ/, x /x/, q /q/, i /i/, j /ʒ/, l /l/, m /m/, n /n/, u /u/, r /r/, ṛ /$r^ʕ$/, ɣ /ʁ/, s /s/, ṣ /$s^ʕ$/, š /ʃ/, t /t/, ṭ /$t^ʕ$/, w /w/, y/ j/, z /z/ and ẓ /$z^ʕ$/ (Múrcia & Zenia, 2015). Phonological values usually match those of the Alphabetic Phonetic Alphabet (IPA, 2023). Pharyngealized phonemes /$d^ʕ$/, /$r^ʕ$/, /$s^ʕ$/, /$t^ʕ$/ and /$z^ʕ$/ and the pharyngeal fricative /ħ/ are transcribed by means of a dot under the letter: ḍ, ṣ, ṭ, ẓ and ḥ, respectively.

RESULTS

What kinds of plants are there?

No term for the word ‘plant’ was mentioned during our interviews, even though such a word is recorded in Tašlḥit dictionaries. *Imɣi* means ‘seedling’ and ‘sprout’, but is also used for ‘vegetation’, ‘vegetal’, and ‘plant’. The word derives from *mmɣi*, ‘to germinate’. The neologism *timɣit* is given for ‘plant’ in Chaffik’s Amazigh-Arabic dictionary (1996). The absence of a general word for ‘plants’ is common in other cultures (Berlin, 1992; Martin, 1995). Often, the plural Moroccan Arabic words *nbatat* and *rbiʕ* are used to talk about ‘cultivated’ and ‘not-cultivated’ plants in general, and the terms *lʕšub* (Moroccan Arabic) and *isafarn* (Tašlḥit) are used to refer to medicinal plants. Fourteen Tašlḥit words that label more inclusive categories of plants (at folk generic, intermediate and life form ranks) and plant uses were identified in this study, as they are often used to refer to plants for which the names are not known (Table 1).

Table 1. Local plant descriptive words and botanical equivalents in alphabetical order.

Tašlḥit word	Botanical equivalence & examples
Aɣalim, aɣanim	Cane; *Arundo donax* L., *Phragmites australis* (Cav.) Steud.
*Ajəjjig**	Flower; *Hypericum hircinum* L., *Pentanema montanum* (L.) D. Gut.Larr., Santos-Vicente & al.
Ajjrid, ag^{w}jjif	Palm; *Chamaerops humilis* L., *Phoenix dactylifera* L.

Aknari	Succulent; *Sedum ssp., Euphorbia ssp., Opuntia ficus-indica* (L.) Mill.
*Amud**	Seed; *Cistus laurifolius* L., *Anethum foeniculum* L.
*Anqqaš**	Hemicryptophyte*; Bellis caerulescens* (Coss.) Coss. ex Ball*, Paronychia argentea* Lam.
*Aẓalim**	Onion; *Drimia maritima* (L.) Stearn, *Asphodelus tenuifolius* Cav.
Ifski	Chamaephyte; *Cladanthus scariosus* (Ball.) Oberpr. & Vogt, *Thymus saturejoides* Coss.
*Iẓuran**	Roots; *Pterocephalus depressus* Coss. & Balansa, *Armeria alliacea* (Cav.) Hoffmanns. & Link
*Lwaya**	Liana; *Lonicera implexa* Aiton, *Hedera maroccana McAll*.
Tamšfalt	Vine; *Bryonia cretica* L., *Rubia peregrina* L.
*Taqqayt**	Unripe, small fruits; *Prunus amygdalus* Batsch, *Juglans regia* L.
*Taskra**	Hemicryptophyte*; Onopordum dyris* Maire*, Echinops spinosissimus* Turra
*Tirkmt**	Turnip; *Brassica rapa* L., *Bryonia cretica* L.
Tšjrt, asyar	Phanerophyte; *Quercus ilex* L., *Pinus halepensis* Mill.
*Xizzu**	Carrot; *Torilis arvensis* (Huds.) Link*, Daucus carota* L.
*Zzrb**	Fence; *Rubus ulmifolius* Schott*, Searsia tripartite* (Ucria) Moffett

*Labels for categories that are not life forms.

Tuga is one of the most used descriptive terms, generally referring to herbaceous plants collected as fodder for livestock, but also used to refer to weeds and plants in general in other contexts. Although this term is sometimes equivalent to the cross-cutting category 'weeds', in Tašlḥit it also carries utilitarian meaning. *Tuga* have no woody parts and roughly correspond to the hemicryptophytes or therophytes categories of plant life forms in the Raunkiær system (Raunkiær, 1934). *Tuga* could also be translated as 'grass' although the category is wider than just plants from the Poaceae family. Sometimes the word *tuga* is locally translated as *rbiʕ* in Moroccan Arabic, but although all *tuga* are *rbiʕ*, not all *rbiʕ* are *tuga*, as examples below show. *Anqqaš* and *taskra* are folk generic terms describing hemicryptophytes too. *Anqqaš* refers to plants with a basal leaf rosette and *taskra* to spiny plants. Participants pointed out that although *taskra* is a type of *rbiʕ* ('weed'), it is not *tuga* because it cannot be used as fodder. The category of *ifski* widely refers to 'shrubs and bushes' including chamephytes and small phanerophytes, plants with woody stems branching from the base or with several stems growing from the base. *Tuga* and *ifski* are differentiated by the survival of the aerial parts from

drought; *ifskan* (plural of *ifski*) are present all year round, but *tuga* dies out in the spring and summer months. The terms *taddagt* and *tašjrt*, which are more commonly used (Tašlḥit word derived from the Moroccan Arabic *šjra*) refer to trees. *Aknari* labels most succulent plants, including various native *Euphorbia* and *Sedum* species and the non-native *Opuntia ficus-indica* (L.) Mill. *Tamšfalt* are vines, which would creep on the ground if they don't find a support to climb. The word literally translates as 'to go up'. The Moroccan Arabic term *lwaya* is also used to refer to ornamental, exotic, and cultivated creeping plants. *Xizzu, tirkmt* and *aẓalim* describe Tašlḥit plant names according to their underground organs' morphology: taproots (*xizzu* means 'carrots' and *tirkmt*, 'turnip') and bulbs (*aẓalim* means 'onions'). The term *iẓuran* (*aẓur* in singular) is also widely used and can directly be translated as 'roots', however, it has only a utilitarian meaning; it refers to plants whose roots are used medicinally, usually collected from alpine areas and traded by shepherds down to the valley villages. Useful roots collected from other environments may also be called *iẓuran* but would not be considered part of the complex of 'roots' when the term is used to label the category. Another recorded utilitarian category is *zzrb*, 'fence', which includes thorny or prickly plants used to build enclosures to keep animals in or out. *Ajjrid* (or also *ag^{w}jjif*) and *aɣalim* (local phonetic variant of the more common word *aɣanim)*, 'palm' and 'cane' respectively, are unaffiliated taxa *sensu* Hunn (1976). Plants with conspicuous flowers are sometimes called *ajəjjig*, literally 'flower'. Interestingly, a word to designate 'fruit' was not reported. The word *amud* or 'seed', was sometimes used, and unripe, small fruits were called *taqqayt*, *taqqayin* in plural (a word generally referring to other small globular objects).

Where do plants grow?

Forty-five different terms and definitions describing ethnoecological categories of the local landscape were mentioned by at least two study participants (SM2). Of these, around 30 represented habitats in which plants grow (Figure 2). Not all of them describe vegetation habitats as the participants also mentioned abiotic factors to conceptualise and order their environment. These terms are used to communicate about and interact with different elements of their surroundings, such as plants.

The study participants identify the landscape around them as *adrar* ('mountainous area', *idrarn* in plural). The terms labelling mountain parts (e.g., *aɣulid* 'cliff', *iɣulidn* in plural) are many, including the steep, inaccessible, *ajgal* ('high elevation part of the mountain', *ijgula* in plural) and *draʕ* ('accessible, less steep area above *ajgal', drwaʕ* in plural). *Asttif* ('white stone', *isttifn* in plural) and *akal umlil* ('white soil'), are both used to describe higher elevations, while *akal azgg^{w}aɣ* ('red soil') is used to describe middle elevations. There are different types of dry environments, such as *lxla* ('non-forested, dry slopes with open access') where animals are allowed to graze throughout the year, *lbur* ('non-forested, dry slopes where dry farming is practised') and *tagant* ('forested, dry slopes with planted conifer trees', *taganin* in plural). *Tagant* is state-managed forest where livestock is not allowed to graze until the trees have reached a certain size. There are also ethnoecological categories containing *aman* ('water'). Water features include *lʕin* ('spring', *lʕyun* in plural = *aɣbalu*, *iɣbula* in plural), *targa* ('cemented irrigation canal', *tirgiwin* in plural), *asaru* ('non-cemented irrigation canals', *isura* in plural), *asif* ('seasonal stream and river', *isaffn* in plural), *amazzr* ('waterfall', *imuzzar* in plural), *afraw* ('water basin') that store water for agricultural purposes, *ššarij* ('reservoir of drinking water') and smaller *talat* ('seasonally water-filled groove', *talatin* in plural) leading to larger *iɣzr*

(‘seasonally water-filled ravine’, *iɣzran* in plural). Other environments sustaining plant life include the side of the *ašanti* (‘road’) and *aɣaras* (‘footpath’, *iɣarasn* in plural), *igr* (‘irrigated terraced field’, *igran* in plural; diminutive *tigrt, tigratin* in plural), *tabḥirt* (‘small cultivated plot’, *tibḥirin* in plural), *adwwaṛ* (‘village’, *idwwaṛn* in plural), *jjrda* (‘garden’, or *urti*, *urtan* in plural) and *agdal* (‘locally managed and traditionally protected montane area’, *ig^{w}daln* in plural; Auclair & Alifriqui, 2012). *Ig^{w}daln*, etymologically related to the place name Imgdal, are spaces where collective management practices maximise the extractive yield of fodder or wood by a commonly agreed prohibition on extraction during a certain period, often spring and early summer (Dominguez & Benessaiah, 2017). There are many types of *agdal*, with alpine pasture lands being the most important in terms of area and complexity of management generally named *ig^{w}daln n tuga* (Auclair & Alifriqui, 2012). Ukaymdn has the presence of an *agdal*, known as *almu* (which means ‘grassy and wet meadow, pastureland, grazing land’), located at elevations between 2600 and 3260 metres above sea level (Nieto, 2014; Coste-El Omari, 2016). *Almu agdal* is a plateau filled with a dense floral cover during the summer months, stream banks covered with lush herbaceous vegetation surrounded by high elevation mountain slopes containing a great number of hardy alpine plants. The *agdal* is closed for grazing between the 15th of March and 10th of August (Parish, 2002). The transhumance settlements inside the *agdal* are called *lʕzzb* when they are temporary and *amazir* (*imizar* in plural) when they are long-lived camps. Smaller areas of restricted access to resources by customary law, namely *tig^{w}dalin* (plural of *tag^{w}dalt*), are present in Imgdal. These are plantations of *Juglans regia* L. ‘common walnut’ along mountain creeks fed by seasonal snowmelt with understoreys rich in fodder plants, which are only harvested in late summer when other resources have dried out or have been depleted. In Ukaymdn these areas are also called *ig^{w}daln*.

Different habitats are defined by their biotic and abiotic features, with one of the most important determining factors being access to water. Wet environments have reliable flowing bodies of water from man-made infrastructure, such as a system of irrigation canals, that transport melted snow and rainwater to *afraw* or *ššarij* and from them to cultivated areas. Dry environments, such as the different types of dry slope: *lbur*, *tagant* and *lxla*, depend on direct precipitation and meltwater running through *iɣzran* and *talatin*. The boundary between a dry and wet environment is often sharp, recognised by dramatic differences in soil and vegetation. Also, wet environments are often marked with some type of human built border since the irrigated lands are privately owned and often used for agricultural purposes. Smaller wet spaces within larger dry areas are also present, such as the microhabitats surrounding a *lʕin*. In these wet microhabitats, water-loving plants grow almost side-by-side with species preferring arid conditions.

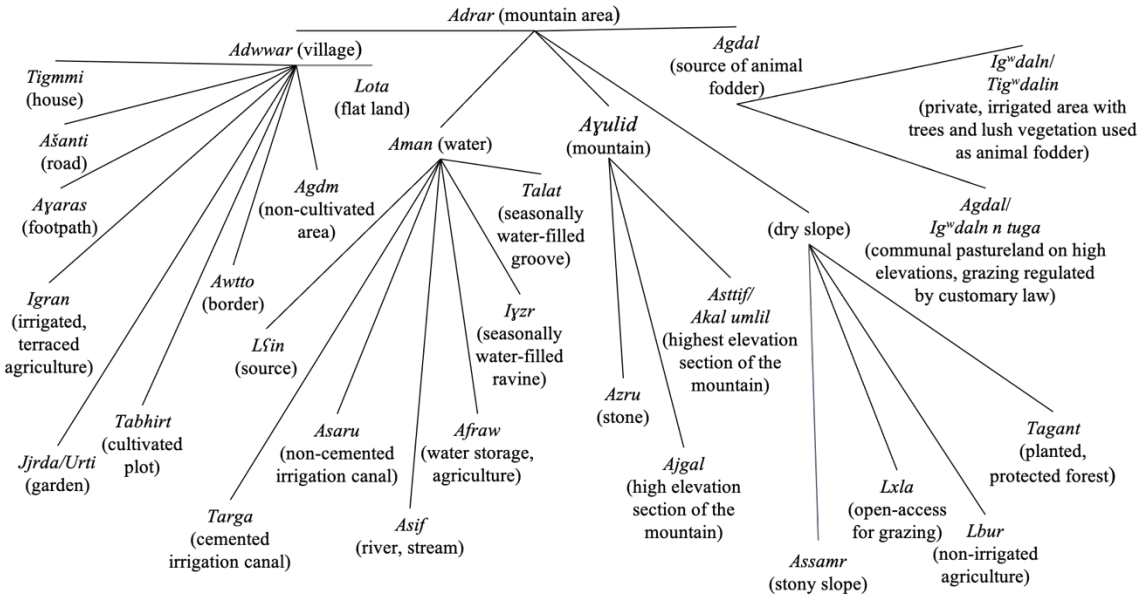

Figure 2. Classification of High Atlas ethnoecological categories.

Names express relations between plants and with place

Tašlḥit plant names often reveal perceived relationships between plants, as demonstrated by the 156 we documented through structured interviews. This can be encoded in the use of the same lexeme for different species, using modifiers in complex names (Table 2), by using feminine forms of a name or by explicitly using kinship terms. *Igg* (*Pistacia atlantica* Desf.), *imidk* (*Pistacia lentiscus* L.) and *wingg* (*Searsia tripartita* (Ucria) Moffett) are phylogenetically related plants and their names are formed from the same lexical root. Many complex plant names express morphological similarities between taxa (see list of modifiers in Table 2). The two lexemes of the name *tirkmt n tazart* (*Bryonia cretica* L.) express different aspects of the plant morphology in relation to other species; *tirkmt* notes that its roots are similar to 'turnips' and *n tazart* illustrates the similarity between its leaves and those of a fig tree (*tazart*). Expressing morphological similarity between the named species and a more common one is also achieved using feminine terms, which in Tašlḥit are created by adding the prefix t- in the beginning of the word and a suffix -t in the singular and -in or –yin in the plural of regular names at the end: *azuknni* (*Thymus saturejoides* Coss. & Balansa) is a masculine word, whereas *tazuknnit* (*Thymus maroccanus* Ball*, Thymus willdenowii* Boiss.) is the feminine, or *ifzi* (*Marrubium vulgare* L.) and *tifziyin* (*Salvia taraxacifolia* Coss. & Balansa). Feminine terms are also diminutives, as observed among other cultures (i.e., by using similar prefixes and suffixes in the Omani Arabic spoken in Dhofar; Miller & Morris, 1988) and used to name smaller examples of ethnoecological categories (e.g., a *tagʷdalt* is a small kind of *agdal*). In Tašlḥit, feminine words are also used as singulatives for certain plants. For example, the masculine word *alili* labels *Nerium oleander* L. in general, but its feminine form indicates a single bush of *N. oleander*. Plants named with feminine forms are smaller in size or less commonly used. This is the case of *tazuknnit*, used for all *Thymus* species that are not the most abundant *T. saturejoides*. Another example is *tawaẓkkunt* (*Bromus sterilis* L.), which looks like *waẓkkun*

300 (*Avena sativa* L.), but does not produce edible grains. Resemblances with edible or useful
301 species are also expressed by using place epithets, as discussed below. Finally, kinship terms
302 are also used to express similarity; *xalis n ifzi* (*Ballota hirsuta* (Willd.) Benth) literally means
303 'uncle of *ifzi*' (*ifzi* being *M. vulgare*) and is also called *tifziyin*. *Xalis n ušddir*, 'uncle of *ašdir*'
304 (*Parietaria* sp.) was described as similar to *ašdir* (*Rubus ulmifolius* Schott) but without prickles.

305

306 Table 2. Gloss of common modifiers in complex names

Colours and morphologic characteristics	
Amjjuḍ	Bald
Azgzaw / Tazgzawt (*lxḍr* in Moroccan Arabic)	Green
Ijjan	Fragrant, perfumed
Umlil / Tumlilt	White
Animals	
N igḍaḍ (N ugḍiḍ)	Of the birds (of the bird)
N imugayn	Of the buffalos
N uɣyul	Of the donkey
N ubnkal	Of the snake
N uɣrda	Of the mouse
N uzgr	Of the bull
N wudad	Of the mouflon
N wulli	Of the sheep
N wuššn	Of the jackal
Ethnoecological areas	

N lʕin	Of / from the spring
N targa	Of / from the irrigation canal
N udrar (N idrarn)	Of / from the mountain (mountains)
N ugdal	Of / from the *agdal*
N uɣulid	Of / from the scree or rocky slopes
N umdduz	Of / from the waste area
N umalu	Of / from shady areas
N usammr	Of / from sunny areas
N uẓru	Of / from the rock
N waman	Of / from the water
N wasif	Of / from the stream or river
N wurti	Of / from the garden
N yigran	Of / from the fields

Uses

N ssabun	Of the soap (for washing)
N uzbar	Of the pain (for treating pain)
N warras	Of the waste (for cleaning)

Complex names can also express similarity between plants and animals. For instance, according to our informants, *Sedum* species resemble a snake (*abnkal*) resulting in names such as *tabnkalt* (*Sedum acre* L.) and *taknarit n ubnkal* (*Petrosedum sediforme* (Jacq.) Grulich; 'small succulent of the snake'). Another example is *ils n uzgr* (*Plantago major* L.; 'tongue of the bull') or *lhbq n uɣyul (Mercurialis annua* L.; 'basil of the donkey', presumably because it looks like basil, but does not smell as good). References to animals in plant names

highlight the cultural salience of the mentioned animals (Khasbagan, 1996). Contrast between similar species can also be achieved through the dichotomy *abldi* (literally 'local') and *arumi* (literally Roman and therefore 'foreign'), as in *aṣfṣaf* (*Populus alba* L.) and *aṣfṣaf n urumi* (*Populus nigra* L.; 'foreign poplar'). The use of *arumi* indicates that the species is not native, or less abundant, than the *abldi* one. Generally, *abldi* plants are more valued than *arumi* ones.

Mobilising plants as a resource is based on knowledge of their ecology. Some plants grow in dry or wet habitats, or in some cases, a certain plant would be known to only grow in one specific landscape type. Some plant names situate plants in locally identified ethnoecological categories (Table 2); *tuga n lʕin* (*Adiantum capillus-veneris* L.; 'weed of the water source') or *anqqaš n waman* (*Sonchus maritimus* subsp*. aquatilis* (Pourr.) Nyman; '*anqqaš* of the water'), vocalise the affinity of these plants to water. A plant's affinity for one particular habitat will often be used as a descriptive when people do not know the plant's name; we recorded the expression *tuga n waman* ('weed of the water') as being used for over ten plant species that grow along streams, irrigation canals, and other wet environments. A similar expression is *tuga n yigran* ('weed of the fields') referring to plants that grow in the fields as weeds, or around them, in the typical mosaic, semi-natural, valley-bottom landscape.

References to space do not only refer to the physical environment, but can indicate morphological similarity between a wild or less useful plant in comparison to a cultivated species as in *taswikt n yigran* (*Plumbago europaea* L.; 'walnut of the fields') and *maṭiša n yigran* (*Solanum americanum* Mill.; 'tomato of the fields'). The weedy *Asphodelus tenuifolius* Cav. can be called *aẓalim n yigran, aẓalim n lbur* or *aẓalim n udrar* ('onion of the fields', 'onion of the dry slopes', or 'onion of the mountain'), contrasting with *azalim*, which is the edible onion. *N yigran, lbur* and *n udrar* can be used as an equivalent of 'wild' or 'local' (*abldi*) relative to the cultivated species. This suggests that, although these three environments are clearly distinguished by locals in terms of the vegetation they hold and the traditional practices carried in each of them, they represent a single metaphorical attribute, namely 'wildness'. This can also be achieved by using references to animals; *n igḍaḍ* ('of the birds') and *n wulli* ('of the sheep') are used in such a way, possibly because they feed on such plants.

Plant names reveal interactions with other culturally and linguistically distinct groups

Various plants have names that explicitly or implicitly evidence cross-cultural interactions beyond the High Atlas. For example, the word 'tomato' comes from the Nahuatl *tomatl* and has been adapted into Tašlḥit and Moroccan Arabic as *maṭiša*, probably from the Castilian plural *tomates*. This word then is used to form complex names *maṭiša n igḍaḍ* or *maṭiša n yigran* (*S. americanum*; 'tomato of the birds' or 'tomato of the fields'). Other loan words include the Moroccan Arabic word *lmrḍ,* literally 'sickness', used in the name *lmrḍ asmmawd* (*Piptatherum caerulescens* P.Beauv.; 'the sickness of the sickle'). Loanwords are not common, but nonetheless key to understanding the social relationships of the Tašlḥit speakers with neighbouring linguistic groups. The local *xzzamt* (*Lavandula pedunculata* (Mill.) Cav.) is derived from the diminutive of the Moroccan Arabic generic name for *Lavandula* species, *xzzama*. Loan Arabic names are also used for *zzit* (*Olea europaea* L.) and *ṛṛmman* (*Punica granatum* L.), both species with high economic value in the Mediterranean, and also of high religious importance as they are mentioned in the Quran. *Mrdədduš* (*Origanum compactum* Benth.) and *lʕtarša* (*Pelargonium odoratissimum* [Soland.]) are loan names from Moroccan

Arabic, possibly because they are both cultivated aromatic species non-native to the High Atlas that might have been initially planted and used by local populations in contact with the Arabs. Moreover, Moroccan Arabic names for traded species that also have a Tašlḥit name were also mentioned by informants, as they need to communicate about these species in Moroccan Arabic (Table 3).

Table 3. Recorded Moroccan Arabic names for local plants

Botanical species	**Tašlḥit**	**Moroccan Arabic**
Ceratonia siliqua L.	*Takidut* (pl. *tikida*)	*Xrrub*
Foeniculum vulgare Mill.	*Wamsa*	*Bəsbəs*
Juglans regia L.	*Taswikt*	*Grgaʕ*
Lavandula dentata L.	*Timzzurri*	*Xzzama*
Malva neglecta Wallr.	*Tibi* / *tibbi*	*Xʷbbiza*
Rubia peregrina L.	*Tarubyi*	*Fuwa*
Ruta chalepensis L.	*Awrmi*	*Fijla*
Thymus saturejoides Coss. & Balansa	*Azuknni*	*Zʕṭər*

A richer corpus of vocabulary is associated with species that are traded or exchanged through networks beyond the community. Two herbs, *T. saturejoides* and *Lavandula dentata* L.*,* are traded in great quantities from Imgdal. Locally called *azuknni* and *timzzurri*, they reach the markets as *zʕṭər* and *xzzama*, respectively. However, neither *zʕṭər* nor *xzzama* are solely *T. saturejoides* and *L. dentata*. *Zʕṭər* includes other thyme species such as *tiqqi n uẓru* (*T. willdenowii*), also called *tifskit n tzuknnit* (‘small *ifski* of *tazuknniṯ*’), and the various species of the *tazuknnit* generic category (*T. saturejoides, T. maroccanus, T. willdenowii, Micromeria hochreutineri* Maire). *T. saturejoides* can be considered part of the *tazuknnit* generic category when flowers are white (an uncommon variety) in which case it is also named *azuknni umlil* (‘white thyme’). Similarly, *xzzama* does not only include *timzzurri* (*L. dentata*), but also the less common *xzzama* (*L. pedunculata* or *Lavandula stoechas* L.) and *grzɣyal* (*Lavandula maroccana* Murb. or *Lavandula multifida* L.). Whereas locals will always differentiate between these three taxa, middlemen use solely the name *xzzama*, adapting the nomenclature to optimise trade with Moroccan Arabic speakers in the urban areas. Once *timzzurri* (*L. dentata*; which can be mixed or not with other lavenders) reaches the market, its distinct smell compared to other lavender species drives a variation in names used in the market; xzz*ama bəldiya* (‘local lavender’) or *xzzama lḥlḥaliya* or even *lḥlḥal* will be used by Moroccan Arabic speaking sellers. The name *taḥlḥalt* (a Tašlḥit word from the Moroccan Arabic *ḥəlḥal*) has also been recorded for *L. dentata* in Imgdal, but it is never used in daily conversation, which suggests that some locals are familiar with the commercial names used by traders.

Plant names indicate their uses

We have so far highlighted how knowledge about plant morphology and relatedness, and notions of natural and social space, are encoded in nomenclature. The utilitarian nature of traditional knowledge is also expressed in plant names, providing clues to how the plants are used. Descriptive expressions in relation to use are common when people don't know the plant's name; *tuga n uẓbar* ('weed of the pain') is often used to refer to some medicinal plants such as *tuga n lʕin* (*Adianthus capillus-veneris* L.) and *tiqqi n uẓru* (*T. willdenowii*). *Grzɣyal* (*L. maroccana* or *L. multifida*) was referred to as *ifski n lqhwa* ('shrub of the coffee') by one informant as it is often used to flavour coffee. Sometimes, epithets that refer to plant uses are part of complex names; *ifski n warras* (*Cladanthus scariosus* (Ball) Oberpr. & Vogt) and *tuga n ṣṣabun* (Not identified) indicate plant uses as brooms and soaps, respectively. Feminine-diminutive names that indicate use are also found; *tatayt* (*Micromeria* sp.; 'little tea') is used in a similar manner as *ataɣ*, 'tea', and *tiḥlibin* (plural of *taḥlibt*) (*Pulicaria odora* (L.) Rchb.; 'little milk') is used for veterinary purposes, to enhance lactation in cows (*ḥlib* being 'milk').

Loss of ethnobotanical and ethnoecological vocabulary in the High Atlas

In the past decades, remote High Atlas valleys have transformed due to the introduction of modern institutions and infrastructure, such as schools and medical centres, cemented irrigation canals, asphalted roads, running water, electricity and gas stoves. One consequence has been the literal distancing of younger generations from the traditional subsistence activities of their parents and grandparents, through attendance in formal schools, locally or in distant towns. Since knowledge of plants' identity, ecology, suitable collection periods, preparation techniques and properties is transmitted orally, there are now fewer and fewer opportunities for younger people to acquire it. Furthermore, young people use Moroccan Arabic at an increasing rate as an outcome of improved transportation routes, resulting in migration of young people to Arabic speaking urban centres outside of the High Atlas for work and study. Moroccan Arabic has become a symbol of youth and modernity, while Tašlḥit is seen as old fashioned. Similarly, people view the traditional agro-pastoralist livelihood as outdated and backwards whereas positive views of recently introduced fruit orchards, signalling a growing reliance on the market economy. For example, *agrtil* (traditional rugs made from *Juncus acutus* L.) are no longer woven since cheap substitutes can be bought in the urban markets. These trends encourage young adults from the High Atlas valleys to migrate to urban centres in search of wage labour or to transition to commercial cultivation of fruit trees, which disrupts the relationships nourishing ecological knowledge resulting in a significant loss of biocultural diversity.

We could observe that some participants had stopped livelihood practices requiring close interactions with their environment and ecological knowledge, such as habits of storing medicinal plants for the winter season or transhumance to *almu agdal*. At the same time, we observed new ways of applying local ecological knowledge. For example, a group of young women in Ukaymdn reported that they preferred to not join middle-aged women in collecting plant in nearby locations, but that they enjoyed day trips to more distant areas for recreational purposes where they could also collect medicinal plants.

Social change is not the only threat to biocultural diversity. The decrease in precipitation, along with warmer and shorter winter seasons, was also perceived by older participants as a cause of biocultural diversity loss.

DISCUSSION

Plant names express the relation of plants to one another and to animals, encode landscape categories, express utilitarian and non-utilitarian values of biodiversity, and document socio-economic interactions between the Tašlḥit speaking community and other communities. Plants are sought in specific environments, with water being the most important element structuring space, and these are sometimes referred to in plant names. We observe a fluidity in naming that contrasts with scientific taxonomy, but that reflects diverse knowledge and multiple values of the local environment present among the Tašlḥit speakers.

Diverse knowledge and values underpin plant and landscape terminology

Indigenous peoples and local communities develop referential systems that allow them to establish intellectual as well as practical relationships to biotic and abiotic space within their effective environment in which they live (Meilleur, 2010). These systems are underpinned by diverse knowledge held by different members of the community (e.g., McCarter & Gavin, 2015) as well as a multiplicity of values of nature (IPBES, 2022). This diversity and multiplicity are evident, for example, in the use of life form terms that are not always mutually exclusive in Tašlḥit, since they carry complementary meanings. For example, *xizzu n igḍaḍ* (*Torilis arvensis*; 'carrot of the birds') can be considered *tuga* (as 'weed'), *ifski*, *ajəjjig* and *xizzu*. *Tuga* refers to its use as fodder, *ifski* points out the overall appearance and *ajəjjig* and *xizzu* are indicative of particular characteristics of the flowers and roots, respectively. People do not follow a single set of classification criteria (Randall, 1976) and classification systems as used in ordinary daily situations are inherently flexible with classifying priorities being context dependent (Alcántara-Salinas et al., 2016, Hunn, 1982). Moreover, life form words are used differently amongst informants: whereas *ifski* is always used to refer to small bushes (chamaephytes), *tšjrt* is used to name trees by most informants, but was used to refer to herbs, bushes, shrubs and palms by others (see SM1).

The use of one descriptive term or name for more than one plant taxa or ethnoecological category by different informants may reflect degrees of knowledge and identification skills based on an informant's idiosyncratic experience with plants (Mathez-Stiefel & Vandebroek, 2011), but also differences in experiencing the environment between informants, especially in situations of rapid change. The lack of consensus regarding the meaning of the Tašlḥit term *tagant* and the Moroccan Arabic term *lɣabt* is a clear example of this. Our research suggests that *tagant* and *lɣabt* were once regarded as synonyms for a local landscape category equivalent to 'bare mountain slope', but are now differentiated from each other. A majority of the participants said that *lɣabt* was the Moroccan Arabic translation of *tagant*, while others claimed that *lɣabt* was the younger plantation of trees while *tagant* was the older forest. Two female participants argued that *tagant* was a place without trees, contradicting all other participants. These two women stated that before the start of the conifer plantations, *lɣabt* and *tagant* meant the same thing, but thereafter people needed a way of differentiating between planted and unplanted slopes. An old man said that the word *tagant* had been introduced to make people aware that an area was planted and closed for grazing livestock. Thus, we can

speculate that perhaps the disagreement found among our participants reflects the recent transformation of the landscape and the introduction of a new landscape category, a plantation of conifer trees. Berkes and Turner wrote that during its initial phase "…a human-environment relationship may change as a society develops knowledge, practices and institutions, coming to collective terms with the limits of their new environment" (2006: 491). The plantations might be too young to have had time to become fully integrated into the ethnoecological classification system (i.e., where its name is more commonly agreed upon). These areas were managed and utilised differently before the introduction of the plantations and the currently used terms may have held different meanings historically. In Imgdal *tagant* refers to steppes and scrublands. If *tagant* previously held the same meaning in Ukaymdn this may be an explanation for the high degree of variation.

Social spaces and cross-cultural relationships also leave an imprint in botanical nomenclature (Chirkova et al., 2016; Soyolt et al., 2013). Names for imported cultivated plants are likely to be loaned from the languages where the crops come from (Wild, 1970; Williamson, 1970) as is the case for some crops in the High Atlas. In culturally and linguistically diverse social landscapes, it is common for binomial plant names to combine lexical items from different languages (Van Andel et al., 2014), as we observe in Tašlḥit plant classification too. Plant names are likely to change along trade networks. When traders and consumers belong to different ethnicities, the nomenclature used for traded plant products will vary at different points along the trade route (Otieno et al., 2015; Williams et al., 2001). This dynamism in names reflects the complex interactions of people, cultures and languages, some ancient and some emerging in new ecological, economic and social contexts. This makes a seemingly simple exercise of identifying a plant being sold in a marketplace more complicated than you'd expect, as we observed for two commonly traded herbs, *T. saturejoides* and *L. dentata*.

Through our analysis of the plant lexicon, we observe that intrinsic, relational, utilitarian and economic values are interlinked in plant naming as well as in labelling ethnoecological categories, and plant names and ethnoecological categories are in turn are related to each other.

Landscape and the intrinsic link between biological, cultural and linguistic diversity

Knowledge is inextricably linked to the physical space in which it is developed and put into practice (Basso, 1996). References to space are common in naming plants evoking both their concrete ecological characteristics, their habitat or cultural values associated with ethnoecological categories. How people see landscape and its biodiversity is determined by both social and ecological factors (Anderson, 2016), which we also observe for the Tašlḥit speaking Išlḥiyn peoples of the High Atlas. The cultural and social production of space results in terminology referring to social-ecological areas where human-biodiversity relations are enacted, but also biodiversity that is at the same time part of the natural environment and an actor in cultural reproduction.

Landscape ethnoecological classifications "…highlight features of the landscape useful for people making a living of the land" (Johnson & Hunn, 2010: 3). In this paper we documented ethnoecological categories determined by specific management practices such as *igran*, *ig^{w}daln* and *tagant*, but also sets of abiotic landscape features of high significance to the participants' subsistence such as *aɣulid* and *asif* which regulate vital access to water. These

environments defined by Tašlḥit speakers correspond to the scientific habitat classifications in Morocco described by Fennane (2006). This classification distinguishes wet habitats (*aman*) including temporary flowing water (*asif*, *targa*, *asaru*) and water sources (*lʕin*), dry, seasonal herbaceous formations (*lbur*, *lxla*), where the human impact in removing the tree cover is particularly important, dry forest (*tagant*), as well as artificial landscapes such as vegetable gardens and agricultural lands (*igran*), gardens (*jjrda* or *urtan*) and anthropogenic environments such as rural dwellings (*idwwaṛn*) and communication routes (*ašanti*).

Socio-environmental change affects local ecological knowledge

The presence, knowledge and use of non-native plants and their influence in Tašlḥit native plant names evidences the dynamic relationships between the Tašlḥit speakers and the world beyond the High Atlas. Nonetheless, recent rapid processes of social change threaten Tašlḥit linguistic and cultural diversity along with the local biodiversity. These transformations originate from modernisation, urbanisation and globalisation, three universal phenomena that tend to result in the homogenization of culture and language, leading to a decline of local ecological knowledge as well as loss of biodiversity (Gorenflo et al., 2012). This development puts pressure on the existence of marginalised groups depending on "…embodied knowledge, skills gained through years of first-hand experience immersed in a particular landscape, and practical know-how shaped by culturally situated practice[s]" (Zarger, 2011: 372).

Given the importance of water in structuring the landscape and sustaining plant life, climate change is likely to have a severe impact on Tašlḥit speaking communities. Climate change threatens both biodiversity, the human populations depending on it for subsistence, survival and identity, and their relations (Salick & Byg, 2007; Savo et al., 2016). Climate models have predicted a decline in plant biodiversity in alpine regions (Kullman, 2004; Walther, 2004) including the High Atlas (Shilling et al., 2012), in line with the observations made by local communities. Irrigated *igran* and *ig^{w}daln* were perceived as more resistant to drought than other High Atlas areas. Perhaps this perception will lead to an increased dependence on cultivated plants from irrigated environments in the future, increasing the pressure on water resources and catalysing a shift away from rain-fed agriculture and other aspects of mountain livelihoods.

Local ecological knowledge is dynamic, always under reconstruction (Agrawal, 1995). Morocco's population is growing rapidly, followed by an increased rate of urbanisation causing environmental degradation and new types of land use (Crawford, 2008; Lehzam, 2012; El Garouani et al., 2017; Haut Commissariat au Plan du Maroc, 2017). These changes can lead to the loss of both practical, material and more cognitive or symbolic uses, which increases the risk of losing local ecological knowledge and therefore its role in adaptation (Meilleur, 2010). Even though the present processes of change are extreme regarding their speed and vastness; they might not result in a complete loss of this knowledge, but only in new ways of applying it. With remote, economically and politically marginalised alpine areas being predicted to be among the most affected by present and upcoming processes of population growth, environmental degradation and climate change, with expected ramifications for food and health security due to their dependence on natural resources from fragile ecosystems (Salick and Byg, 2007), High Atlas people will be increasingly dependent on their ability to adapt. Therefore, it is of great importance for the Išlḥiyn to maintain their local ecological

knowledge, which has made them capable of utilising the rich High Atlas biodiversity for many generations.

CONCLUSION

Plant names express the intrinsic link between biological, cultural and linguistic diversity in the High Atlas that is constructed through Tašlḥit speaking people's experience and practice on the land. Plant names encode information about relations to habitat, use, and trade, as well as local perceptions of what biological diversity is and how species are related to one another. Documentation of folk names contributes to the conservation of biocultural diversity, endangered by socio-economic as well as environmental and climate change.

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DECLARATIONS

Ethical approval

Approval from the Ethics Committee of the School of Biological Sciences, University of Reading, was obtained for the work in Imgdal (Research Ethics Project Submission SBS14-1505). For the work in Ukaymdn, we obtained ethical approval from the School of Anthropology and Conservation at the University of Kent ().

Competing interests

The authors declare no conflicts of interest.

Author's contributions

H.S., I.T.T, G.J.M., J.A.H, and R.K.P designed the study. H.S. and I.T.T collected data. H.S., C.M., A.O., and I.T.T. analysed data. H.S. and I.T.T wrote the main manuscript with contributions by all co-authors. All authors reviewed the manuscript.

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Availability of data and materials

Data used for this article have been made available through a Supplementary Material file.

REFERENCES

Agrawal, A. (1995). Dismantling the Divide between Indigenous and Scientific Knowledge. *Development and Change,* 26(3), 413-439.

Alcántara-Salinas, G., Ellen, R.F., & Rivera-Hernández, J.E. (2016). Ecological and behavioral characteristics in grouping Zapotec bird categories in San Miguel Tiltepec, Oxaca, Mexico. *Journal of Ethnobiology, 36*, 658-682.

Atauri, J.A. & de Lucio, J.V. (2001). The role of landscape structure in species richness distribution of birds, amphibians, reptiles and lepidopterans in Mediterranean landscapes. *Landscape Ecology, 16*, 147-159.

Anderson, E. N. (2016). Ethnobiology and the New Environmental Anthropology. In: H. Kopnina, & E. Shoreman-Ouimet (Eds.), *Routledge Handbook of Environmental Anthropology.* Routledge. Retrieved August 27, 2017, fromhttps://www.routledgehandbooks.com/doi/10.4324/9781315768946.ch3

Auclair, L. & Alifriqui, M. (2012). *Agdal: patrimoine socio-écologique de l'Atlas marocain.* El Maarif Al Jadida, Rabat.

Basso, K.H. (1996). *Wisdom sits in places: landscape and language among the Western Apache.* University of New Mexico Press, Albuquerque.

635 Berkes, F. & Turner, N.J. (2006). Knowledge, Learning and the Evolution of Conservation
636 Practice for Social-Ecological System Resilience. *Human Ecology, 34*(4), 479-494.

637 Berlin, B. (1973). Folk systematics in relation to biological classification and nomenclature.
638 *Annual Review of Ecology and Systematics*, *4*, 259–271.

639 Berlin, B. (1992). Ethnobiological Classification: Principles of Categorization of Plants and
640 Animals in Traditional Societies. Princeton University Press.

641 Björa, C.S., Wabuyele, E., Grace, O.M., Nordal, I. & Newton, L.E. (2015). The uses of Kenyan
642 aloes: an analysis of implications for names, distribution and conservation. *Journal of*
643 *Ethnobiology and Ethnomedicine*, *11*, 82.

644 Blanco, J. & Carrière S.M. (2016). Sharing local ecological knowledge as a human adaptation
645 strategy to arid environments: Evidence from an ethnobotany survey in Morocco. *Journal of*
646 *Arid Environments*, *127*(2016), 30-43.

647 Blondel, J. (2006). The 'design' of Mediterranean landscapes: a millennial story of humans
648 and ecological systems during the historic period. *Human Ecology*, *35*(5), 713-729.

649 Bugalho, M.N., Caldeira, M.C., Pereira, J.S., Aronson, J. & Pausas, J.G. (2011).
650 Mediterranean cork oak savannas require human use to sustain biodiversity and ecosystem
651 services. *Frontiers in Ecology and the Environment*, *9*(5), 278-286.

652 Chaffik M. 1996. *Arabic-Amazigh dictionary*. Volume 3. Ircam edition.

653 Chirkova, K., Huber F.K., Weckerle, C.S., Daudey, H. & Pincuo, G. (2016). Plant names as
654 traces of the past in Shuiluo valley, China. *Journal of Ethnobiology, 36,* 192-214.

655 Coste-El Omari M. (2016). *À la découverte de la flore de L'Oukaïmeden Haut Atlas de*
656 *Marrakech*. Direct Print, Casablanca.

657 Crawford, D. (2008). *Moroccan households in the world economy: Labour inequality in a*
658 *Berber village.* Louisiana State University Press, Baton Rouge.

659 Davis, D. (1996). Gender, indigenous knowledge, and pastoral resource use in Morocco. *The*
660 *Geographical Review, 86*(2), 284-288.

661 Dominguez, P. & Benessaiah, N. (2017). Multi-agentive transformations of rural livelihoods in
662 mountain ICCAs: the case of the decline of community-based management of natural
663 resources in the Mesioui agdals (Morocco). *Quaternary International*, *437*, 165-175.

664 El Garouani, A., Mulla, D.J., El Garouani, S. & Knight, J. (2017). Analysis of urban growth and
665 sprawl from remote sensing data: Case of Fez, Morocco. *International Journal of Sustainable*
666 *Built Environment*, *6*, 160-169.

667 Fennane, M., Ibn Tattou, M., Mathez, J., Ouyahya, A. & El Oualidi, J. (eds.), (1999, 2007,
668 2015). *Flore pratique du Maroc. Manuel de détermination des plantes vasculaires. Vols. 1-3.*
669 *Institut Scientifique.* Université Mohammed V, Rabat.

670 Fennane, M. (2006). Equisse des bases d'une typologie des habitats au Maroc. *Bulletin de*
671 *l'Institut Scientifique, Rabat*, *28*, 1-5.

672 Gauquelin, T., Michon, G., Joffre, R., Duponnois, R., Genin, D., Fady, B., Bou Dagher-Kharrat,
673 M., Derridj, A., Slimani, S., Badri, W. & Alifriqui, M. (2018). Mediterranean forests, land use

674 and climate change: a social-ecological perspective. *Regional Environmental Change*, *18*(3),
675 623-636.

676 Gorenflo, L.J., Romaineb, S., Mittermeierc, R.A. & Walker-Painemillad, K. (2012). Co-
677 occurrence of linguistic and biological diversity in biodiversity hotspots and high biodiversity
678 wilderness areas. *Proceedings of the National Academy of Sciences of the United States of*
679 *America*, *109*(21), 8032-8037.

680 HCPS, Haut Commissariat au Plan de la Statistique. (2004). *Résultat du Recensement*
681 *général de la population et de l'habitat 2004.* Retrieved August 13, 2017, from
682 http://rgph2014.hcp.ma/Resultat-du-Recensement-general-de-la-population-et-de-l-habitat-
683 2004_a59.html

684 Haut Commissariat au Plan de la Statistique. (2014). *Recensement général de la population*
685 *et de l'habitat.* Rabat, Morocco.

686 Haut Commissariat au Plan du Maroc. (2017). *Les projections de la population et des*
687 *ménages entre 2014 et 2050.* Retrieved August 17, 2017, from http://www.hcp.ma/Les-
688 projections-de-la-population-et-des-menages-entre-2014-et-2050_a1920.html

689 Heywood, V.H. (1995). The Mediterranean flora in the context of world biodiversity. *Journal of*
690 *Mediterranean Ecology, 21*, 11–18.

691 Hunn, E. (1976). Toward a perceptual model of folk biological classification. *American*
692 *Ethnologist, 3,* 508-524.

693 Hunn, E. (1982). The utilitarian factor in folk biological classification. *American Anthropologist,*
694 *84*, 830-847.

695 Hunn, E. (2006). Meeting of minds: how do we share our appreciation of traditional
696 environmental knowledge? *Journal of the Royal Anthropological Institute, 12*, 143-160.

697 Hunn, E.S. & Meilleur, B.A. (2010). Toward a theory of landscape ethnoecological
698 classification. In L.M. Johnson and E.S. Hunn (Eds.), *Landscape Ethnoecology: Concepts of*
699 *Biotic and Physical Space* (pp. 15-26). Berghan Books, Oxford.

700 IPA (International Phonetic Association). (2023). *International Phonetic Association.* Retrieved
701 November 10, 2022, from https://www.internationalphoneticassociation.org/

702 IPBES (2022). Methodological Assessment Report on the Diverse Values and Valuation of
703 Nature of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem
704 Services. Balvanera, P., Pascual, U., Christie, M., Baptiste, B., & González-Jiménez, D. (eds.).
705 IPBES secretariat, Bonn, Germany.

706 Johnson, L.M. & Hunn, E.S. (2010). Introduction. In L.M. Johnson & E.S. Hunn (Eds.),
707 *Landscape Ethnoecology: Concepts of Biotic and Physical Space* (pp. 1-11). Berghahn Books,
708 Oxford.

709 Khasbagan, C.S. (1996). The cultural importance of animals in traditional Mongolian plant
710 nomenclature. In C. Humphrey & D. Sneath (Eds.), *Culture and environment in Inner Asia:*
711 *Society and culture* (pp. 25-19). The White Horse Press, Winwick.

712 Kullman, L. (2004). The changing face of the alpine world. *IGBP, Global Change Newsletter*,
713 *57*, 12–14.

714 Lévi-Strauss, C. (1962). *La Pensée sauvage*. Librairie Plon, Paris.

715 Lehzam, A. (2012). *Le développement urbain au Maroc: Challenges et Perspectives.*
716 Unpublished poster presentation at: Future Challenges of the New Urban World: What Model
717 of Development for the Moroccan City? 1-2 October, 2012, Rabat, Morocco.

718 Maffi, L. (2007). Biocultural diversity and sustainability. In J. Pretty, A. Ball, T. Benton, J.
719 Guivant, D.R. Lee, D. Orr, M. Pfeffer & H. Ward (Eds.), *The SAGE Handbook of Environment*
720 *and Society* (pp. 267-277). SAGE Publishing, London.

721 Martin, G.J. (1995). *Ethnobotany: a methods manual.* Chapman & Hall, London.

722 Mathez-Stiefel, S.L. & Vandebroek, I. (2011). Distribution and transmission of medicinal plant
723 knowledge in the Andean highlands: a case study from Peru and Bolivia. *Evidence-Based*
724 *Complementary and Alternative Medicine*, *2012*(5), ID 959285. doi:10.1155/2012/959285

725 McCarter, J. & Gavin, M.C. (2015). Assessing variation and diversity of ethnomedical
726 knowledge: A case study from Malekula Island, Vanuatu. *Economic Botany*, *69*, 251-261.

727 Medail, F. & Quezel, P. (1997). Hot-spots analysis for conservation of plant biodiversity in the
728 Mediterranean basin. *Annals of the Missouri Botanical Garden*, *84*(1), 112-127.

729 Meilleur, B.A. (2010). The structure and Role of Folk Ecological Knowledge in Les Aulles,
730 Savoie (France). In: L.M. Johnson &E.S. Hunn (Eds.), *Landscape Ethnoecology: Concepts of*
731 *Biotic and Physical Space* (pp. 159-174). Berghahn Books, Oxford.

732 Miller, A.G & Morris, M. (1988). *Plants of Dhofar (The southern region of Oman; traditional,*
733 *economic and medicinal uses).* The office of the Adviser for Conservation of the Environment,
734 Diwan of Royal Court, Sultanate of Oman.

735 Múrcia, C. & Zenia, S. (2015). *Diccionari català-amazic / amazic-català. Estàndard del*
736 *diasistema amazic septentrional.* Llibres de l'Índex, Barcelona.. Online version:
737 www.amazic.cat.

738 Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. & Kent, J. (2000).
739 Biodiversity hotspots for conservation priorities. *Nature*, *403*, 853-858.

740 Nieto, C. (2014). Tradition and Modernity in the Oukaïmeden Valley: Changes in the Rites and
741 Practices of Seasonal Transterminance. *Complutum*, *25*(2), 191-207.

742 Otieno, J., Abihudi, S., Veldman, S., Nahashon, M., van Andel, T., de Boer, H.J. (2015).
743 Vernacular dominance in folk taxonomy: a case study of ethnospecies in medicinal plant trade
744 in Tanzania. *Journal of Ethnobiology and Ethnomedicine, 11*, 10.

745 Parish, R. (2002). Mountain Environments. Routledge, London.

746 Puri, R.K. (2010a). Participatory Mapping. In H. Newing (Ed.), *Conducting Research in*
747 *Conservation: A Social Science Perspective (pp. 187-198).* Routledge, London.

748 Puri, R.K. (2010b). Documenting Local Environmental Knowledge and Change. In H. Newing,
749 (Ed.), *Conducting Research in Conservation: A Social Science Perspective* (pp. 126-152).
750 Routledge, London.

751 Randall, R.A. (1976). How tall is a taxonomic tree? Some evidence for Dwarfism. *American*
752 *Ethnologist*, *3*, 543-553.

Raunkiær, C. (1934). *The life forms of plants and statistical plant geography; being the collected papers of C. Raunkiaer.* Clarendon Press, Oxford.

Salick, J. & Byg, A. (2007). *Indigenous Peoples and Climate Change.* Report of Symposium 12-13 April 2007. Tyndall Centre for Climate Change Research, Oxford.

Savo V., Lepofsky D., Benner J.P., Kohfeld K.E., Bailey J., Letzerman K. (2016). Observations of climate change among subsistence-oriented communities around the world. *Nature Climate Change, 6,* 2958.

Soyolt, Galsannorbu, Yongpink, Wunenbayar, Guohou Liu & Khasbagan. (2013). Wild plant folk nomenclature in the Arhorchin national nature reserve, Inner Mongolia, PR China. *Journal of Ethnobiology and Ethnomedicine*, *9*, 30. https://doi.org/10.1186/1746-4269-9-30

Teixidor-Toneu, I., Martin, G.J., Ouhammou, A., Puri, R.K. & Hawkins, J.A. (2016). An ethnomedicinal survey of a Tashelhit-speaking community in the High Atlas, Morocco. *Journal of Ethnopharmacology*, *188*, 96-110.

Teixidor-Toneu, I., M'Sou, S., Salamat, H., Ait Baskad, H., Ait Illigh, F.., Atyah, T., Mouhdach, H., Rankou, H., Ait Babahmad, R., Caruso, E., Martin, G. & D'Ambrosio, U. (2022). Which plants matter? A comparison of academic and community assessments of plant value and conservation status in the Moroccan High Atlas. *Ambio, 51*, 799-810.

Van Andel, T., van't Klooster, C.I.E.A., Quiroz, D., Towns, A.M., Ruysschaert, S. & van der Berg, M. (2014). Local plant names reveal that enslaved Africans recognized substantial parts of the New World flora. *PNAS, 111*(50). E5346-E5353. https://doi.org/10.1073/pnas.1418836111

Walther, G-R. (2004). Plants in a warmer world. *Perspectives in Plant Ecology, Evolution and Systematics, 6*, 169-185.

WFO (World Flora Online). (2023). *World Flora Online.* Retrieved January 5, 2023, from http://www.worldfloraonline.org.

Wild, J.P. (1970). Borrowed names for borrowed things? *Antiquity, 44*(174), 125-130.

Wilder, B.T., O'Meara, C., Monti, L. & Nabhan, G.P. (2016). The importance of indigenous knowledge in curbing the loss of language and biodiversity. *BioScience*, 66(6), 499-509.

Williams, V.L., Balwill, K. & Witkowski, E.T.F. (2001). A lexicon of plants traded in the Witwatersrand umuthi shops, South Africa. *Bothalia, 31*, 71-98.

Williamson, K. (1970). Some food plant names in the Niger Delta. *International Journal of American Linguistics, 36*, 156-167.

Zarger, R.K. (2011). Learning ethnobiology: creating knowledge and skills about the living world. In E.N. Anderson, D. Pearsall, E. Hunn & N. Turner (Eds.), *Ethnobiology* (pp. 371-387). Wiley-Blackwell, Hoboken.